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described by Tschaschin, Evans and Schulemann, and others, the two common types of connective tissue cells are readily distinguished by their reaction to the vital stain, the clasmatoocytes storing large masses, the fibroblasts much more minute granules of the dye. It can not be denied that the delicate punctate and rod-like deposits of isamine blue, as seen in fibroblasts, often make an astonishingly close approach to mitochondria in appearance. But are they mitochondria? This question could only be answered by applying to the cells in question the criteria for the recognition of mitochondria, which are well known to cytological technique. We have confined ourselves to three methods, which have been pursued until they yielded constant and reliable results. These are the iron hematoxylin method, the aniline acid-fuchsin methyl-green method (Bensley), and supra-vital staining with janus green (Michaelis, Laguesse, Bensley, Cowdry).

On studying in this way the fibroblasts of the mouse, mitochondria can easily be demonstrated. They disagree in several respects with the alleged isamine blue mitochondria. The true mitochondria are always scantier in number than the deposits of isamine blue which occur in fibroblasts of chronically stained animals, and they are more definitely threadlike than the isamine blue structures. Further, it is quite possible to see the unstained mitochondria lying between the isamine blue granules in living cells, examined immediately after removal from the body, and finally, by staining with janus green, one can see these previously unstained structures now add themselves to the number of stained cytoplasmic elements, where their peculiarities as regards color, shape, size and arrangement are still retained. These conclusions obtain even more emphatically with trypan blue and presumably with all of the benzidine dyes.

In the vital staining with azo dyes, it is not true, consequently, as Tschaschin maintains, that we have a vital staining of the mitochondrial apparatus in some cells, in addition to the gross reception of the dye by the macrophages. Indeed, Tschaschin believes that in the macro-

phages themselves the mitochondria are stained vitally, but that here they are exclusively granular, spherical forms, and suffer all stages of transformation into the large "secretory" granules. The methods detailed for the study of fibroblasts yield essentially similar results when applied to the macrophages. These, in contradistinction to the claim of Tschaschin, have true mitochondria, some of them filiform, among the azo dye granules.

This discussion has wider implications, for Tschaschin's ideas have been accepted by Kiyono even though he recognizes some anomalous aspects of such a conclusion. Kiyono seems willing to believe that the macrophages may react to these dyes in a phagocytic or physical way but that this can not be the explanation for all the granules produced by these dyes, since the reception and storage of foreign substances by some of the other cells which are vitally stained is a phenomenon unknown by other methods. This argument seems beside the point. We can only state that in no case known to us have the granules produced by vital azo dyes been found to be identical with the mitochondria of the vitally stained cells.

KATHERINE J. SCOTT

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#### THE AMERICAN PHILOSOPHICAL SOCIETY

THE annual general meeting of the American Philosophical Society was held in the rooms of the society in Philadelphia on April 22, 23 and 24. The meeting was opened on Thursday afternoon by President W. W. Keen, who, with Vice-presidents A. A. Michelson, W. B. Scott and Professor C. L. Doolittle, presided over the various sessions.

On Friday evening a reception was held in the hall of the Historical Society of Philadelphia, at which William Morris Davis, Sc.D., Ph.D., professor emeritus of geology, Harvard University, gave an illustrated lecture "On New Evidence for Darwin's Theory of Coral Reefs." The lecture described the chief results of a Shaler Memorial Voyage across the Pacific in 1914, with studies of the Fiji group, New Caledonia, the Loyalty Islands, the New Hebrides, the Great Barrier Reef of Australia and the Society Islands.

On Saturday afternoon a symposium was held on the Figure, Dimensions and Constitution of the Interior of the Earth. The subject was discussed

from the astronomical standpoint by Frank Schlesinger, Ph.D., director of Allegheny Observatory, Pittsburgh; from the geological standpoint by T. C. Chamberlin, Ph.D., LL.D., head of department of geology, University of Chicago; from the seismological standpoint by Harry Fielding Reid, Ph.D., professor of dynamical geology and geography, Johns Hopkins University, Baltimore; from the geophysical standpoint by John F. Hayford, director of college of engineering, Northwestern University, Evanston, Ill.

Fifteen new members were elected, the names of whom have been given in *SCIENCE*, Vol. XLI., page 640. The usual practise of electing foreign members was omitted this year.

The portrait of Dr. Edgar F. Smith, provost of the university and former president of the society, was presented by a donor whose name was withheld. The address of presentation was made by Vice-provost J. H. Penniman.

The meeting closed with a dinner at the Bellevue-Stratford, attended by about one hundred members and guests. The toasts were responded to as follows:

"The Memory of Franklin," by Hon. Simeon E. Baldwin.

"Our Universities," by Professor Harry Fielding Reid.

"Our Sister Societies," by Professor Ernest W. Brown.

"The American Philosophical Society," by Professor Marion D. Learned.

The following papers were presented during the various sessions of the society:

*Devices for Facilitating the Analysis of Observations—More Particularly those of the Tides:* ERNEST W. BROWN.

*On Linear Integral Equations in General Analysis:* ELIAKIM H. MOORE.

The paper opens with a brief account of the author's general theory of linear integral equations, a theory embracing by specialization the regular cases of various classical instances, and in closing it indicates a new general theory intended to embrace the most important irregular cases of the classical instances.

*A Direct Solution of Fredholm's Equation with Analytic Kernel:* PRESTON A. LAMBERT.

*The Existence of a Sub-electron?* ROBERT A. MILLIKAN.

*The Work in Atmospheric Electricity aboard the "Carnegie":* L. A. BAUER AND W. F. G. SWANN.

*Local Disturbances in a Magnetic Field:* FRANCIS E. NIPHER.

*Explorations over the Surface of Telephonic Diaphragms Vibrating under Simple Impressed Sounds:* A. E. KENNELLY AND H. O. TAYLOR.

*The Hall and Corbino Effects:* EDWIN PLIMPTON ADAMS.

The Hall effect is the production of a transverse difference of potential in a conducting sheet when an electric current flows through it and it is placed in a magnetic field perpendicular to its plane. The Corbino effect is the production of a circular current in a conducting disk when a radial current flows through it and it is placed in a magnetic field perpendicular to its plane. This paper describes experiments that have been made to study the latter effect and to show its essential relation to the Hall effect. The symmetry of the experiment arranged for measuring the Corbino effect, as well as the fact that the measurement of the Hall effect requires very thin sheets, gives to the Corbino effect an important position among the galvanomagnetic effects.

*Spontaneous Generation of Heat in Recently Hardened Steel:* CHARLES FRANCIS BRUSH.

The writer shows that the specimens of carbon tool steel and tungsten "high speed" steel examined by him spontaneously generated a very considerable amount of heat at room temperature after being water-hardened at cherry-red or white heat; that the development of heat at steadily diminishing rate was observable more than a month, and was accompanied by shrinkage in volume of the steel. Progress of heat generation and of shrinking is shown in curves. But that shrinking is only incident to, and is not the prime cause of the generation of heat is evidenced by the fact that the internal work represented by the heat generated is hundreds of times greater than necessary to produce the observed change in volume.

The writer further shows that in the process of hardening, the steels increased at least a half per cent. in volume, evidenced by specific gravity tests of half-inch bars and linear measurements of long thin rods; that when afterward tempered to light-blue color much shrinkage took place at once, followed by more shrinkage when tempered to light-blue color, and another large shrinkage when annealed.

The writer regards the hardened steel as being in a condition of very great molecular strain somewhat unstable at first. Spontaneous relief of a small portion of the strain causes the generation of heat observed until stability at room temperature

is reached. Any considerable rise of temperature, as in tempering, permits further spontaneous relief of strain, or molecular rearrangement, doubtless accompanied by more generation of heat, and so on until annealing temperature is reached. It is obvious that the process of tempering or annealing steel is an exothermic one, and conversely that hardening is an endothermic process.

Diagrams of the apparatus employed are shown and described, and analyses of the steels given.

*Ruling and Performance of a Ten-inch Diffraction Grating:* A. A. MICHELSON.

*One-Dimensional Gases and the Reflection of Molecules from Solid Walls:* ROBERT WILLIAMS WOOD.

*Heredity in Protozoa:* M. H. JACOBS.

In the higher animals, characters are not for the most part directly transmitted from one generation to the next, but develop anew in each generation from the germ-plasm. In the protozoa, on the other hand, there is a mixture of direct transmission and new development that has interesting consequences in the case of the inheritance of newly acquired characters. In this connection a race of *Paramecium* with three contractile vacuoles instead of the usual number of two is discussed, and the means described by which the unusual number is kept from disappearing. The factors concerned seem to be: (a) direct transmission of the extra vacuole, (b) a tendency to adhere to ancestral racial traits, and (c) a new tendency of the protoplasm to produce extra vacuoles.

*The Constitution of the Hereditary Material:* T. H. MORGAN.

*The Problem of Adaptation as Illustrated by the Fur Seals of the Pribilof Islands:* GEORGE H. PARKER.

The Alaskan fur-seal is a pelagic animal that breeds in summer on the Pribilof Islands, Behring Sea. About equal numbers of males and females are born. At the breeding age one male, the bull, becomes associated with a number of females, the cows, thus constituting a harem. A harem may contain as many as 120 cows and probably averages about 30. As a result of this disproportionate relationship as compared with the proportion of the sexes at birth, there are to be found at most breeding-grounds many so-called idle bulls. These are a measure of the inefficiency of organic adaptation. Contrary to the opinion held by many biologists, adaptation is not always a relation of great exactitude, but is often, to use the words of Bateson, a poor fit.

*An Interpretation of Sterility in Hybrids:* EDWARD M. EAST.

*Heterosis and the Effects of Inbreeding:* GEORGE H. SHULL.

Physiological processes are stimulated and rate of growth and total amount of growth increased through the union of gametes having unlike constitution. This physiological effect of the differences in uniting gametes is heterosis. Inbreeding lessens heterosis by gradually lessening the differences between the uniting gametes. The application of this principle to some of the problems of practical breeding was briefly discussed.

*The Significance of Sterility in *Oenothera*:* BRADLEY M. DAVIS.

Studies on the seed, ovule and pollen sterility in *Oenothera* show that there are species with a high degree of fertility and species in which fertility is low, also that hybrids may exhibit a wide range in comparative fertility. These conditions suggest the possibility that hybrids may at times continue indefinitely as impure or heterozygous species through a failure to produce homozygous zygotes or through the mortality of zygotes having homozygous constitutions. *Oenothera lamarckiana* is a form with low seed fertility and a high degree of pollen and ovule sterility, and may be representative of an impure species, hybrid in character, which for the most part breeds true, but occasionally and repeatedly produces other types, the so-called mutants. In genetical work with *Oenotheras* a method of germinating seeds must be employed which will give trustworthy proof that a culture has produced all of the seedlings possible from a sowing of seed-like structures.

*Morphology and Development of *Agaricus rodmani*:* GEORGE F. ATKINSON.

*Agaricus rodmani*, which is closely related to the cultivated mushroom, *Agaricus campestris*, has a thick, double annulus, which is divided into an upper and lower limb by a broad, marginal groove nearly reaching the stem. This peculiar annulus, especially the lower limb, has suggested a resemblance to the volva of the *Amanitas*. While it arises from the surface of the pileus margin, and is composed to some extent of a portion of the blematogen, it is not strictly comparable to the volva, since the blematogen in the species of *Amanita* thus far studied is clearly separated from the pileus by a distinct cleavage layer, while in *Agaricus* it remains "concrete" with the pileus.

The pileus and stem fundaments are differentiated by the appearance of an internal, narrow zone of young, slender hyphæ, rich in protoplasm, the primordium of the hymenophore and pileus margin. These hyphæ are directed obliquely downward.

The rapid increase in the elements of this primordium produces a tension on the ground tissue below it, which now lags behind in growth, so that it is torn apart, forming an annular cavity in the angle between the stem and pileus.

The pileus margin and the hymenophore primordium increase in a centrifugal direction. The palisade stage of the hymenophore begins next the stem. In certain individuals it also extends partly down on the stem. The hymenophore primordium consists of a zone of parallel, slender hyphæ, the ends of which are not crowded, thus presenting a more or less frazzled appearance on its lower surface. The transition to the palisade stage occurs by the increase in number of these hyphæ and the broadening of their free ends.

The lamellæ originate as radial, downward-growing salients of the palisade zone, beginning next the stem, in some individuals also arising on the upper part of the stem. Since the growth and increase of these parts of the hymenophore, as well as that of the pileus margin, is centrifugal, all stages of the young hymenophore are therefore found in a single individual during an intermediate stage of its development; the zone of gill salients next the stem, followed by the palisade zone, and outside of this the primordial zone.

*The Large-fruited American Oaks:* WILLIAM TRELEASE.

*Relationships of the White Oaks of Eastern North America:* M. V. COBB.

*The Present Need in Systematic Botany:* L. H. BAILEY.

*A Convenient Form of Receiver for Fractional Distillations under Diminished Pressure:* MARSTON T. BOGERT.

A simple form of apparatus was exhibited and described which permits the collecting and measuring of fractions of any size and number.

*The Cymene Carboxylic Acids:* J. R. TUTTLE AND MARSTON T. BOGERT.

The authors have prepared the two isomeric p-cymene carboxylic acids, p-cymene 2-carboxylic acid and p-cymene 3-carboxylic acid, from the corresponding bromo compounds, by the well-known Barbier-Grignard reaction (metallic magnesium and anhydrous ether, followed by carbon dioxide).

Small amounts of the 2-acid have been obtained heretofore by other investigators, and a few salts have been recorded; but we believe that this is the first time that the acid has been obtained in sufficient amount to be extensively studied. The authors have prepared, in addition to the free acid, various salts, esters and other derivatives.

The isomeric 3-acid appears to be entirely new. Its properties and those of certain of its derivatives are described by the authors.

These acids are members of the benzoic acid series, and this paper is therefore a contribution to our knowledge of a very important group of organic acids.

*Syringic Acid and its Derivatives:* E. PLAUT AND MARSTON T. BOGERT.

In the bark and leaves of the lilac (*Syringa vulgaris*), and in the bark of the privet (*Ligustrum vulgare*), there occurs a substance which has been called "syringin," "lilacin" or "ligustrin." When this substance is oxidized with potassium permanganate, it yields glucosyringic acid, and this latter is easily saponified to dextrose and syringic acid.

The authors obtained their syringic acid by the method of Bogert and Isham (treating trimethyl gallic acid with fuming sulphuric acid), and have prepared therefrom and studied a number of new derivatives; among them being bromo, nitro, amino and hydroxy syringic acids, esters, acetyl derivatives, and ortho condensation products.

*The Relation of Ductless Glands to Dentition and Ossification:* WILLIAM J. GIES.

*Gastro-Intestinal Studies:* PHILIP B. HAWK.

*On the Rate of Evaporation of Ether from Oils and its Application in Oil-ether Colonic Anesthesia:* CHARLES BASKERVILLE.

The rate of evaporation of oil-ether mixtures containing 25, 50 and 75 per cent. of the latter was determined at body temperature. The oils used were olive, peanut, corn, cottonseed, soya bean, cod liver and lanolin.

The speed at which the ether evaporated from the 75 per cent. mixture was found clinically to be the best for introducing and maintaining anesthesia in the human subject by insertion in the colon. The technique is indicated for operations about the head, throat, mouth and the buccal cavity.

Dr. Gwathmey, the senior collaborator has records of over a thousand cases with different operators without a single case of post-anesthesia pneumonia and with nausea reduced to the minimum.

*Oral Endamebiosis:* ALLEN J. SMITH.

*Certain Factors Conditioning Nervous Responses:* STEWART PATON.

*The Rights and Obligations as to Neutralized Territory:* CHARLEMAGNE TOWER.

*Physiographic Features as a Factor in the European War:* DOUGLAS W. JOHNSON.

The paper describes the salient features of geological structure west of the Rhine and explains the influence of this structure upon surface topography. Special attention is given to the Rhine graben and the strong contrast between the steep eastern and gentle western slope of the Vosges; the maturely dissected peneplane of western Germany and the Ardennes, trenched by the incised meandering valleys of the Rhine, Moselle and Meuse; the concentric cuestas northeast and east of Paris with their steep escarpments facing toward the Germans; and the comparatively level plains of central and northwestern Belgium. In the eastern field the East Prussian lake district, the plain of Poland, the Podolian cuesta and the Carpathian Mountains are briefly described.

It is shown that in both theaters of war landforms have exercised an important influence both upon the general plans of campaign and the detailed movements of armies. Topography limited the German invasion of France to four principal routes, which are described and illustrated by lantern views. The violation of Belgian neutrality had a very distinct topographic basis. Russia's plan of campaign has been dictated in part by topographic considerations, and the principal battles in the east have been fought with reference to natural lines of defense which are illustrated by diagrams. Suggestions are made as to the effect of landforms upon probable future movements of the armies.

*Tammuz and Osiris:* GEORGE A. BARTON.

*The Pronouns and Verbs in Sumerian:* J. DYNELEY PRINCE.

*Opium in the Bible:* PAUL HAUPT.

In ten passages of the Old Testament Hebrew *rôsh*, head, denotes a bitter and poisonous plant. It is used also of the poison of serpents. According to Pliny the venom of snakes was nothing but bile. The ancients used the same word for gall, bitterness, poison, medicine. We use "to drug" for "to narcotize," although "drug" originally means simply a dry (German *trocken*, Dutch *droog*) herb. *Rôsh* is mentioned in the Bible in connection with *la'anâh*, wormwood or absinthe.

It was a plant which grew in the furrows of the fields (Hosea, x., 4). The Authorized Version renders "hemlock," but *rôsh*, head, denotes poppy-head, and *mê-rôsh* is opium. Also the gall (*i. e.*, bitter fluid) with wine (not vinegar) in the account of Christ's crucifixion (Matthew, xxvii., 34) and the myrrh in Mark xv., 23 denote opium. The Talmud states that a cup of wine with *lebonâh* was given to criminals before their execution. *Lebonâh* means "incense," as a rule, but in this case it is used for opium. In the fifth chapter of the Alexandrian festal legend for the feast of Purim, known as the Third Book of the Maccabees, we read that wine with incense was given to the elephants before they were let loose upon the Jews. This "incense" may have been a preparation of Indian hemp. Assassin means intoxicated with hashish (*Cannabis Indica*).

*Divisions of the Pleistocene of Europe and the Periods of the Entrance of Human Races:* HENRY FAIRFIELD OSBORN.

*The Occurrence of Algæ in Carbonaceous Deposits:* CHARLES A. DAVIS.

On account of their generally small size and fragile structure, Algæ have not usually been recognized as important contributors to carbonaceous rocks, and some recent students of the microscopic structure of coals have denied the probability of their existence as fossils in carbonaceous rocks. Under certain conditions of deposition and preservation, as yet unknown, Algæ may constitute a large percentage of the recognizable plant remains which have accumulated to form beds of carbonaceous shales of great extent and thickness. Some micro-photographs of Algæ from the oil-yielding shales of Green River age was shown.

*Additions to the Fauna of the Lower Pliocene Snake Creek Beds, Nebraska:* W. J. SINCLAIR.

The Snake Creek beds explored by the Princeton Expedition of 1914 are found in the northwest corner of Nebraska in Sioux Co., and consist of unconsolidated gravels and sands in which water-worn bones of a large number of fossil animals of Lower Pliocene age are found. Most of these remains are fragmentary and there is almost no association of parts. We were fortunate in securing rather better material than has hitherto been collected from this formation, and have a number of new forms now described for the first time. Most of the remains are of horses, of which there were at least a dozen different species on the Lower Pliocene plains of Nebraska, most of them three-toed. There were also several different kinds

of camels, some of them quite large, at least three rhinoceroses, many carnivorous animals, some of large size, at least two mastodons, a peccary, the last of the oreodons or "ruminating hogs" as Professor Joseph Leidy called them, an antelope of entirely new type, quite different from anything hitherto reported from North America, with scimitar-shaped horns sloping backward and curving inward, circular at the base but flattening out toward the tips. There is still another antelope, *Dromomeryx*, but no trace of the pronghorn. In collections made by the American Museum from the Snake Creek beds the first of the bison appears, so the Snake Creek fauna gives us some idea of the kinds of animals on the buffalo range when the buffalo first came, and shows what great faunal changes have taken place even during the lifetime of this genus.

*The Rôle of the Glacial Anticyclone in the Air Circulation of the Globe* (illustrated by lantern slides): WILLIAM H. HOBBS.

The paper presents in outline a theory of nourishment of the great continental glaciers of the polar regions, and shows in what ways this theory, first promulgated by the author in 1910, has been confirmed and extended by the work of the numerous exploring expeditions carried out since that date. It is particularly because the expeditions across Greenland of 1912 (deQuervain) and of 1913 (Koch and Wegener), and those of Scott and Amundsen into the heart of the Antarctic continent, have for the first time penetrated the central areas of continental glaciers that the newer studies are illuminating. The penetration of higher levels of the atmosphere upon the borders of the inland ice through the aid of pilot balloons, has supplied further evidence of great value along a wholly new direction. Most recent of all, the studies of Sir Douglas Mawson within a new section of the Antarctic continental glacier has brought valuable confirmatory observations.

*Note on the Sun's Temperature*: HENRY NORRIS RUSSELL.

The effective temperature of the sun may be computed from Abbot's data for the radiation of each separate wave-length, using Planck's formula. The resulting temperature at the center of the disk is about 6600° when determined from the visible radiation, but 600° lower according to the radiation in the infra-red. The effective temperature at the edge of the sun is more than 1000° lower, which accords with the theory that at the

center of the disk we can see down deeper, into hotter layers.

*Some Results from the Observation of Eclipsing Variables*: RAYMOND S. DUGAN.

Slides showing observed light-curves of three giant eclipsing variables: RT Persei, Z Draconis and RV Ophiuchi; and diagrams of the binary systems whose revolution is supposed to give rise to the observed light variations. The importance of repeatedly observing the entire period shown in the discovery of shallow secondary minima, the oblateness of the stars, inter-radiation and periastron effects and darkening toward the limb. Evidence of the greater brilliance of the advancing side of the bright star. The variation of the periods of these three stars. Early Harvard photographs and recent photometric observations extend the observations of Z Draconis over nearly 7000 periods and of RT Persei over nearly 11,000 periods. Comparison of the visual and photographic light curves.

*The Variable Stars TV, TW and TX Cassiopeiae*: R. J. MCDIARMID.

A brief discussion of the light curves of the variable stars TV, TW, TX Cassiopeiae and T Leonis Minoris was given, pointing out interesting features in connection with each system.

In the system TV Cass. we have two stars of nearly the same size but of different surface brightness, the ratio being 5.5 as to 1.0. In this system other points of interest are brought out, such as the reflection and ellipticity effects. The system TW Cass. represents two stars of almost equal brightness and of nearly the same size, moving in an eccentric orbit. In the third system TX Cass. the two stars are very unequal in size, with a ratio of surface brightness of 1.0 to 1.5. The stars are ellipsoidal in shape, giving rise to an ellipticity effect shown by the light curve. The system is of special interest, as there seems to be little doubt of its being similar to the sun, bright at the center, decreasing in brightness toward the limb. T Leonis Minoris is an eclipsing variable. The ratio of the surface of the two stars in the eclipsing system T. Leonis Minoris is 1 as to 25.

*Radial Velocities in the Orion Nebula*: EDWIN B. FROST.

The investigations of the nebula in Orion by Messrs. Bourget, Fabry and Buisson, of Marseilles, published in the *Astrophysical Journal* for October, 1914, show that the photographic interferometer method can be successfully applied to the study of the radial velocities of the nebula,

both as a whole and in its separate parts. Their conclusions that there are very appreciable motions in closely adjacent portions of the nebula have been confirmed by observations made in the last few weeks with the Bruce spectrograph. Differences of over 10 km. per second in the velocity in the line of sight have been found, and the general effect of rotation of the nebula inferred by the French observers is confirmed by the spectrograph.

*The Euler-Laplace Theorem on the Rounding Up of the Orbits of the Heavenly Bodies under the Secular Action of a Resisting Medium:* T. J. J. SEE.

HORACE CLARK RICHARDS

#### THE AMERICAN PHYSICAL SOCIETY

A REGULAR meeting of the American Physical Society was held at the National Bureau of Standards, Washington, on Friday and Saturday, April 23 and 24, 1915.

##### Friday, 2 P.M.

Hon. William C. Redfield, Secretary of Commerce, opened the meeting with a cordial address of welcome in which he gave strong expression to his interest in the progress of science, and his appreciation of the vital interdependence of physics and the commercial interests of the country.

Papers were presented as follows:

"On the Distributed Capacity of Single Layer Solenoids," by J. C. Hubbard. (By title.)

"The Skin Effect in Bimetallic Wires," by John M. Miller.

"Magnetization by Rotation," by S. J. Barnett.

"Intercomparisons of the Standard Instruments at Magnetic Observatories 1905-1914," by L. A. Bauer.

"Simultaneous Readings in Electrical Measurements, with Demonstration of a New Type of Switch for Facilitating Them," by Walter P. White.

"The General Design of Critically Damped Galvanometers," by Frank Wenner. (By title.)

"Apparatus for the Simultaneous Measurement of Length, Electrical Resistance, and Magnetic Permeability as Functions of the Temperature," by Arthur W. Gray. (By title.)

"The Dielectric Constant of a Heterogenous Dielectric," by H. L. Curtis and M. James.

"The Separately Excited Electrodynamometer

as a Sensitive Galvanometer," by Ernest Weibel.

"The Crushing of a Hollow Conductor by Lightning," by W. J. Humphreys. (By title.)

"Aneroid Barometers," by M. D. Hersey.

"A Method of Measuring Heat Conductivities," by R. W. King.

"Viscosity of Ethyl Ether near the Critical Temperature," by A. L. Clark.

"An Equation of State for Normal Substances, Tested in the Vapor Dome," by Harvey N. Davis.

"The Correction of Echoes in the Auditorium at the University of Illinois," by F. R. Watson. (By title.)

"The Transpiration of Plants in Relation to Temperature and Solar Radiation," by Lyman J. Briggs and H. L. Shantz.

"A Mercurial Barometer in which the Well Setting is Eliminated," by Lyman J. Briggs.

##### Saturday, 9:30 A.M.

"The Reflecting Power of Metals for the Ultra-Violet Region of the Spectrum," by Edward O. Hulburt.

"The Visibility of Radiation in the Red End of the Visible Spectrum," by Edward P. Hyde and W. E. Forsythe.

"The Effective Wave-Length of Transmission of Red Pyrometer Glasses and other Notes on Optical Pyrometry," by Edward P. Hyde, F. E. Cady and W. E. Forsythe.

"The Use of a Hollow Filament with Perforations in the Determination of the Black-body-Temperature and True-Temperature Relation for Tungsten," by A. G. Worthing.

"A Further Extension of the Spectrum in the Extreme Ultra-Violet," by Theodore Lyman.

"The Fluorescence and Absorption Spectra of Uranyl Nitrate," by E. L. Nichols and Ernest Merritt.

"A Precision Artificial Eye," by Herbert E. Ives. (By title.)

"A Flicker Photometer Attachment for a Lummer-Brodhun Photometer Head," by E. F. Kingsbury.

"Color Grading and Color Specifications by Means of the Rotary Dispersion of Quartz," by Irwin G. Priest and Chauncey G. Peters. (By title.)

"A Proposed Method for the Photometry of Lights of Different Colors," by Irwin G. Priest.

"On X-ray Wave-lengths," by William Duane and F. L. Hunt.

"The X-ray Spectrum of Tungsten at Constant Potential," by David L. Webster.